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# Hypothalamo-neurosecretory System of the Marine Teleost, *Ariomma indica* (Day 1870)

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## Abstract

Hypothalamus of *Ariomma indica* (Family Ariommidae) comprises mainly of the nucleus preopticus (NPO), nucleus lateralis tuberis (NLT) and their axonal tracts. NPO is a paired structure located on either side of the third ventricle slightly above and anterior to the optic chiasma. It is highly vascularized structure with broad anterior and narrow posterior ends. NPO is divisible into a dorsal pars magnocellularis (PMC) comprising larger neurosecretory cells and ventral pars like neurosecretory material (NSM) of various sizes are encountered in the NPO and NLT. Neurons of PMC and PPC contribute beaded axons to form the neurohypophysial tract. A few small Herring bodies (HB) are also seen in the neurohypophysis (NH).

## Introduction

Hypothalamus in the vertebrate brain comprises groups of neurosecretory cells that mediate the organismic endocrine responses and adjustments to the environmental changes through the secretion of various tropic hormones of the pituitary by elaborating releasing (-RH) and inhibiting hormones (-IH) (Maksimovich, 1987; Peter *et. al.*, 1991). Hypothalamus also contains receptors specifically sensitive to the hormone which, in turn, regulates its activity through feed back mechanism. There are increasing evidences that in fishes too, the hypophysial functions are modulated by the hypothalamic neurohormones but the regulatory mechanisms have not yet been clearly defined (Maksimovich, 1987, Peter *et. al.*, 1991). Though several workers have described the hypothalamus of various teleosts inhabiting freshwaters (Maksimovich, 1987), such studies are very few among the marine fish (Zolotnitskiy, 1980; Pandey, 1993; Pandey and Mohamed, 1993). Therefore, an attempt has been made to record the hypothalamo -neurosecretory system of the marine teleost, *Ariomma indica*.

## Materials and Methods

40 specimens of *Ariomma (Psenes) indica* (Family Ariommidae) (both sexes) were collected by operating FAO trawl net at 75m depth on Board Sagar Sampada (Cruise No.49) from the north-east coast (17°20' N ; 83°16' E) (Bay of Bengal). Their brain along with the pituitary and a piece of gonads (to judge their maturity stage) were surgically removed and fixed immediately in freshly prepared Bouin's solution. After reaching the laboratory, the tissues were washed thoroughly in running tap water, dehydrated in ascending series of alcohol, cleared in xylene and embedded in paraffin wax at 60°C. Serial sections (sagittal, frontal and horizontal) were cut at 6-8µ. Brain were stained in Mallory's triple, aldehyde fuchsin (AF) and chrome-

alum-hematoxylin-phloxine (CAHP) whereas gonads were stained in hematoxylin-eosin (H&E).

## Results and Discussion

Histological examination of the gonads revealed the fish to be in IV and V stages of maturity.

Hypothalamo-neurosecretory system of *Ariomma indica* comprises mainly of nucleus preopticus (NPO), nucleus lateralis tuberis (NLT) and their axonal tracts. NPO is a paired structure located on either side of the optic chiasma. The broad dorsal end consists of sparsely distributed neurosecretory cells whereas these cells are closely placed towards the middle and ventral portion.

The nucleus preopticus (NPO) is divisible into a dorsal pars magnocellularis (PMC) consisting of large neurosecretory neuronal cells (Fig. 1a-c) and a ventral pars parvocellularis (PPC) with small cells (Fig. 1d-f). Thus, a progressive reduction in the size of neurosecretory cells is seen from the dorsal to the ventral aspect of NPO. The NPO is highly vascularized structure (Fig. 1a) and its neurosecretory cells are positive to aldehyde fuchsin (AF), chrome-alum - hematoxylin - phloxine (CAHP) and acid fuchsin (in Mallory's triple stain). In maturing (Stage IV) specimens of both the sexes, acid fuchsin - positive neurosecretory globule - like material of varying sizes are noticed in PMC (Fig. 1c) and PPC (Fig. 1d,f). Most of the PMC and PPC neurosecretory cells are bipolar and contribute beaded axons to form neurohypophysial tract.

In nucleus lateralis tuberis (NLT), the neurosecretory cells are distributed uniformly in the infundibular floor adjacent to the pituitary stalk (Fig. 1g). These cells are negative to aldehyde fuchsin (AF) and chrome-alum-hematoxylin-phloxine (CAHP) but stain readily with acid fuchsin in Mallory's triple stain (Fig. 1g, h). Based on cell distribution and size, the nucleus

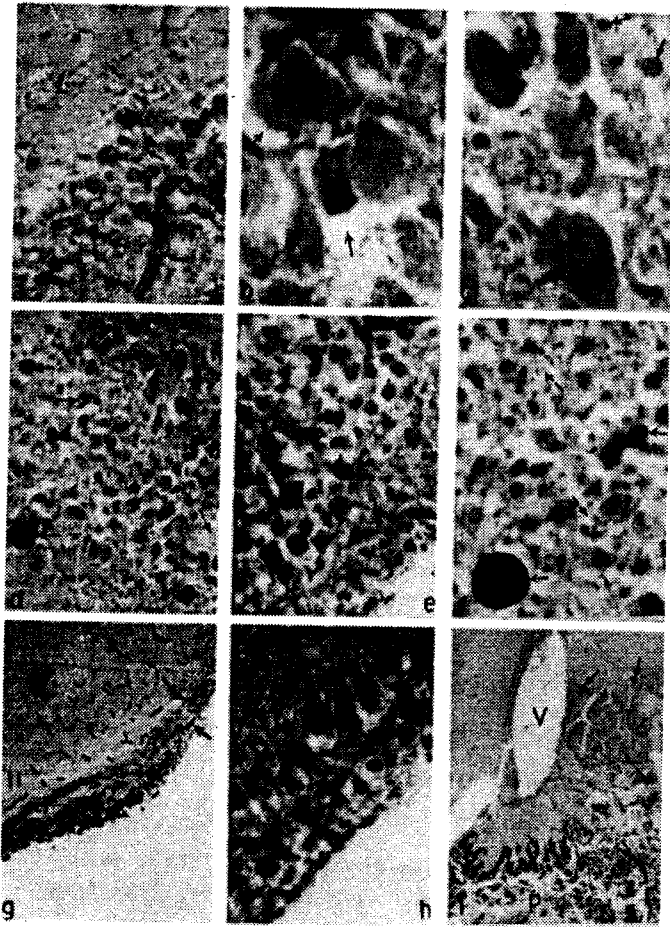


Fig. 1 (a) Nucleus preopticus (NPO) of male *Ariomma indica* showing the distribution of neurosecretory cells and blood vessels (arrow). Mallory's triple x 400.

(b) Pars magnocellularis (PMC) portion of NPO of maturing (Stage IV) female *Ariomma indica*. Mark the large neurosecretory with the signs of vacuolation (arrow). Mallory's triple x 1000.

(c) PMC of maturing (Stage IV) male *Ariomma indica* with large neurosecretory cells and acid fuchsin +ve globule like neurosecretory material (NSM) (arrow). Mallory's triple x 1000.

(d) Nucleus preopticus (NPO) pars parvocellularis (PPC) portion of maturing (Stage IV) female *Ariomma indica* depicting small neurosecretory cells and acid fuchsin +ve colloid-like NSM (arrow). Broken arrows show vascularization of the structure. Mallory's triple x 400.

(e) Magnified view of PPC of maturing male *Ariomma indica* depicting the signs of vacuolation. Mallory's triple x 1000.

(f) PPC of maturing female *Ariomma indica* showing the vacuolation in the neurosecretory cells, acid fuchsin +ve colloid like NSM (arrow) and vascularization (broken arrow). Mallory's triple x 1000.

(g) Nucleus lateralis tuberis (NLT) of maturing female *Ariomma indica*. Mark the active neurosecretory cells and acid fuchsin +ve NSM (arrow). Mallory's triple x 400.

(h) Magnified view of NLT matured females *Ariomma indica* showing the distribution of variously shaped neurosecretory cells with polymorphic nuclei. Mallory's triple x 1000.

(i) Sagittal section exhibiting the attachment of pituitary gland (P) with the brain of *Ariomma indica*. V = Ventricle. Inset: Herring bodies (arrow) in the neurohypophysis. Mallory's triple x 100.

lateralis tuberis (NLT) may be divisible into pars anterior, pars posterior and pars inferior (Fig. 1g). The neurosecretory cells of NLT are variously shaped and their sizes range from very small to the larger ones with polymorphic nuclei (Fig. 1g, h). These neurons are generally bipolar but a few multipolar cells are also observed in NLT of *Ariomma indica*. NLT is highly vascularized structure and a few neurosecretory cells are seen in close association of blood vessels. Further, a few acid fuchsin-positive neurosecretory material are encountered in the NLT of maturing specimens of both the sexes (Fig. 1g).

The neurohypophysial tract (NHT) enters the pituitary through infundibulum (Fig. 1i). Varying sizes of Herring bodies (HB) are also seen in the anterior and posterior neurohypophysis (inset).

The basic cytoarchitectural pattern of *Ariomma indica* hypothalamo - neurosecretory system resembles to those reported for a number of freshwater teleosts (Sathyasesan, 1965; Bhargava, 1969; Chandrasekhar and Khosa, 1972; Viswanathan and Sunderaraj, 1974; Saksena, 1979; Maksimovich, 1987). Generally, the neurosecretory cells of NPO stain with AF and CAHP but they are also stainable with acid fuchsin in *Ariomma indica* (Fig. 1 a-g). Similar staining responses have also been recorded in freshwater clupeid, *Notopterus chitala* (Prakash *et al.*, 1984), Indian mackerel, *Rastrelliger kanagartha* (Pandey, 1993) and the Indian scad, *Decapterus tabl* (Pandey and Mohamed, 1993).

There are reports that NPO is involved in spawning activities and its secretion(s) influences gonadal maturation among teleosts (Viswanathan and Sunderaraj, 1974; Zolotnitskiy, 1980; Prakash *et al.*, 1984; Rai and Pandey, 1986). We observed vacuolation in the neurosecretory cells of PMC (Fig. 1b,c) and PPC (Fig. 1e,f) of maturing (Stage IV) *Ariomma indica*. Viswanathan and Sunderaraj (1974 - *Heteropneustes fossilis*), Tischenko *et al.*, (1976 - *Coregonus autumnalis migratorius*), Saksena (1979 - *Glossogobius giuris*), Moitra and Medya (1980 - *Cirrhinus mrigala*), Zolotnitskiy (1980 - *Scophthalmus maeoticus*) and Rai and Pandey (1986 - *Colisa fasciata*) have also noticed depletion of neurosecretory material during breeding season or after estrogen administration.

We observed acid fuchsin - positive neurosecretory globule-like materials in PMC and PPC of *Ariomma indica* (Fig. 1c,d,e). Such structures have also been reported in the NPO of maturing (Stage IV) and matured (Stage V) specimens of *Porichthys notatus* (Sathyasesan, 1965), *Phoxinus phoxinus* (Bhargava, 1969), *Channa punctatus*, *Clarias batrachus* and *Heteropneustes fossilis* (Chandrasekhar and Khosa, 1972), *Glossogobius giuris* (Saksena, 1979), *Scophthalmus maeoticus* (Zolotnitskiy, 1980), *Notopterus chitala* (Prakash *et al.*, 1984), *Rastrelliger kanagartha* (Pandey, 1993) and *Decapterus tabl* (Pandey and Mohamed, 1993).

Nucleus lateralis tuberis (NLT) is the second neurosecretory centre in the teleostean hypothalamus, however, there are reports of its absence in a few fishes (Kabayoshi *et al.*, 1959; Saksena, 1979; Prakash *et al.*, 1984; Maksimovich, 1987). Kobayashi *et al.*, (1959) had remarked that season or age factors might be responsible for the absence of stainable neurosecretory material in the NLT. The neurosecretory cells of NLT pars anterior, pars posterior and pars inferior (Fig. 1g) of maturing *Ariomma indica* appear active and stain readily with acid fuchsin. NLT cells of other marine teleosts like *Rastrelliger kanagurta* (Pandey, 1993) and *Decapterus tabl* (Pandey and Mohamed, 1993) also exhibited almost similar staining response. NLT cells of *Heteropneustes fossilis* (Viswanathan and Sunderaraj, 1974) and *Colisa fasciata* (Rai and Pandey, 1986) get stimulated during breeding season or after estrogen administration indicating its role in the reproductive physiology of the fish. Interestingly, we noticed acid fuchsin - positive neurosecretory material in NLT of maturing *Ariomma indica* (Fig. 1g).

Herring bodies (HB) are seen in the anterior and posterior neurohypophysis of *Ariomma indica* (Fig. 1i, Inset). Sathyanesan (1965 - *Porichthys notatus*), Bhargava (1969-*Phoxinus phoxinus*), Saksena (1979 - *Glossogobius giuris*), Zolotnitskiy (1980 - *Scophthalmus maeoticus*), Pandey (1993-*Rastrelliger kanagurta*) and Pandey and Mohamed (1993-*Decapterus tabl*) have also recorded a similar distribution of such structures which are assumed to be accumulated neurosecretory material (Sathyanesan, 1965; Bhargava, 1969; Saksena, 1979; Zolotnitskiy, 1980).

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